

Abstract

The project focus is to assemble a prototype which uses a **Software Defined Radio (SDR)** running specified software in a host computer to replicate the behavior of an expensive oscilloscope and reduces the cost of envelope detection.

Background

The NHMFL works with **Nuclear Magnetic Resonance (NMR)** for research purposes to determine the structure of a range of molecules.

An SDR is a communication system that can be used to measure **Radio Frequencies (RF)**.

Functionally, the prototype must demonstrate the envelope of incoming and reverse RF signals coming from the NMR probe.

A **Bidirectional Coupler** is used to sample small amounts of input signal power for measurement purposes and is connected to the NMR probe to feed out an RF signal to the SDR for analysis.



Figure 1. NMR probe & Bidirectional Coupler (left); Adalm-Pluto SDR (right)

Detailed Block Diagram

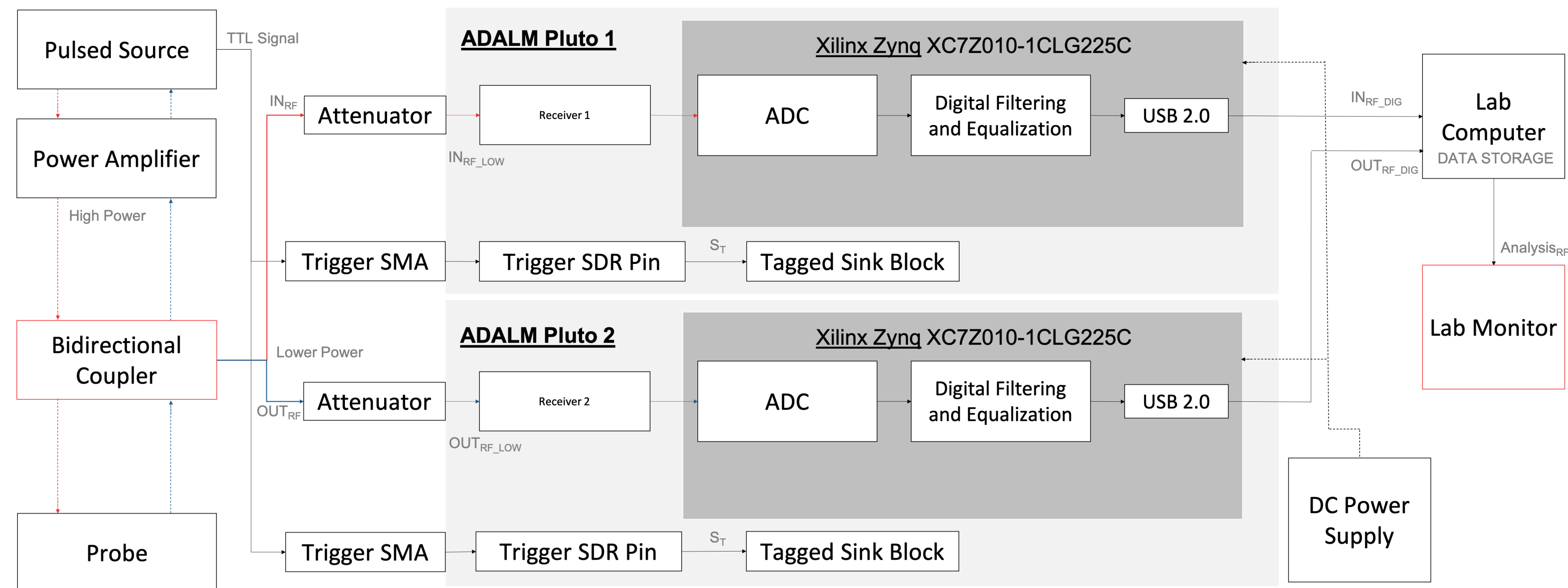


Figure 2. Block diagram demonstrating signal flow of all inputs, outputs, and internal signals of the system in addition to all included internal components, and external hardware

Selected Design

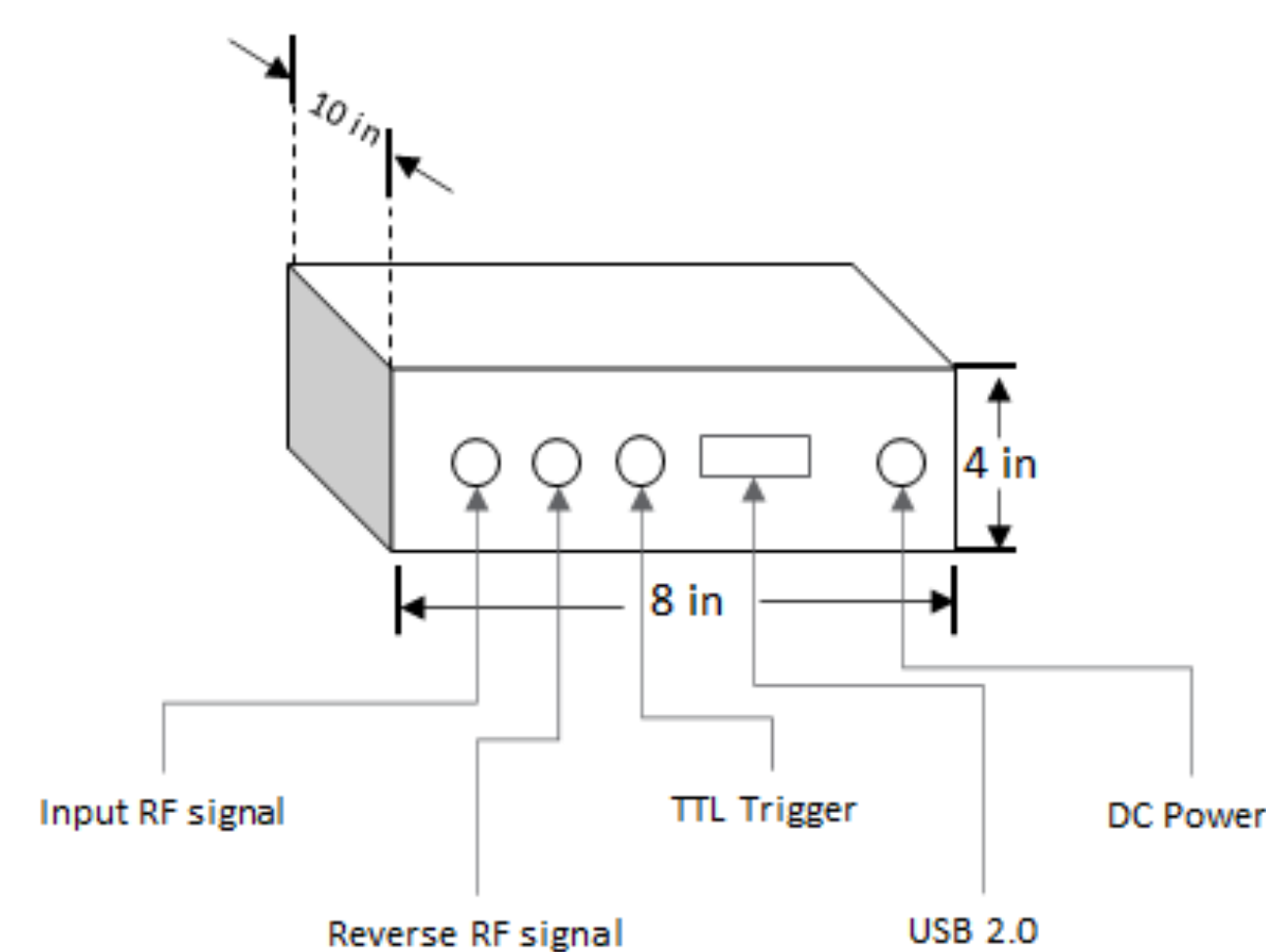


Figure 3. 3D view of prototype schematic schematic & assembly

High Power Tuning

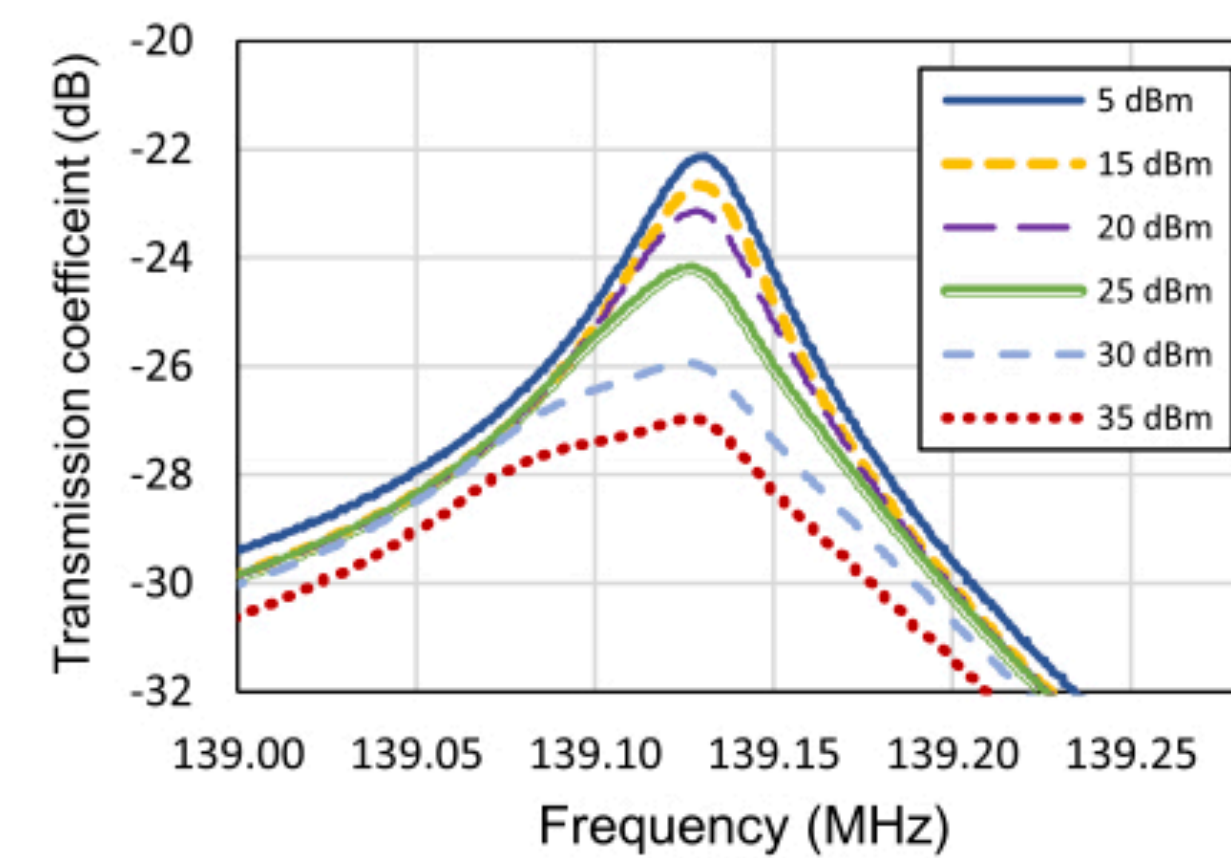


Figure 4. Result of tuning the high-power reverse RF signal coming from the probe

Project Constraints

Total Cost < \$1000 & no NI components.

Potential Challenges

- Trigger implementation on each SDR.
- Trigger pin identification on SDR.
- Synchronization of two output digital signals.
- Plotting two signals in a single scope.
- Single DC power input for two SDRs.

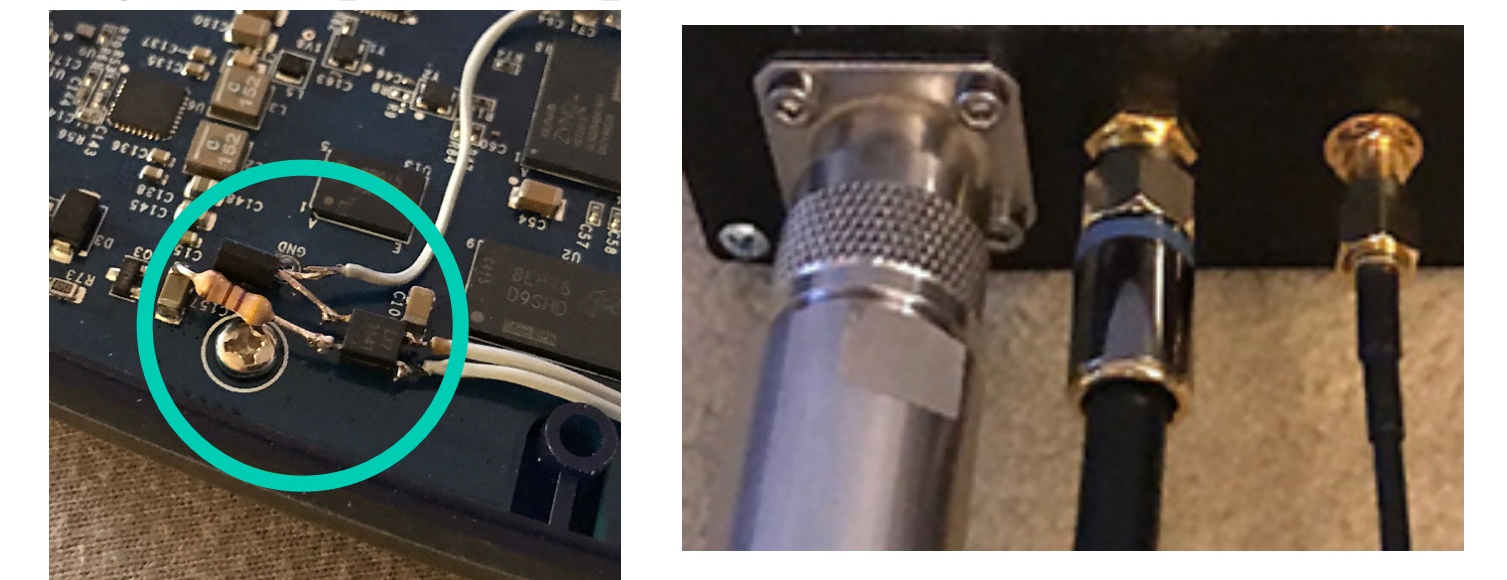


Figure 5. Soldered SDR example trigger pin connection (left); example prototype I/O (right)

Future Work

- Correction of two SDR coupling implementation.
- Trigger implementation and testing with low frequency signals using function generator.
- System assembly and software integration.
- Prototype testing with RF signals.
- 3D prototype case design and printing, full component assembly within case.
- Final verification of prototype.

Acknowledgements

Team 307 would like to thank Dr. Oscar Chuy and Dr. Jerris Hooker for their time and valuable insight provided whilst teaching the class. We would also like to thank Dr. William Brey, Magnetic Lab Research Faculty and our appointed project customer; Paul Holcomb, Keysight technologies oscilloscope expert and our appointed technical advisor; Dr. Rejendra Arora, our assigned team advisor; and lastly our reviewers Dr. Bing Kwan and Dr. Uwe Meyer-Baese. Thank you all for your support.